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ABSTRACT

This paper deals with a study designed to pursue the question; "What treatment by whom is most effective for this individual with that specific problem under which set of circumstances?" One of the objectives of the study was to determine if there was any relationship between two predictor variables, personality type (extraversion-introversion) and perceptual orientation (field independence--field dependence); and treatment effects as shown by four criterion variables: (1) a knowledge test, (2) a simulation test, (3) frequency, and (4) variety of career exploratory behaviors. A stepwise regression procedure was used to analyze the data. No significant relationships were found between treatment effects and predictor variables. A variety of difficulties which may have contributed to these results were identified and implications for future research were presented. (Author)

Employing Regression Analysis to Test Aptitude-Counseling Treatment Interactions

A paper presented at the
American Educational Research Association
symposium on effects of aptitude-treatment
interaction variables

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by

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Introduction

The need for experimental studies in counseling which use a variety of criteria and which contrast competing treatments for different types of clients has been increasingly stressed (Kiesler, 1966; Paul, 1967; Thoresen, 1969). Indeed main effects of treatments may have little meaning in the presence of interactions, and variables not represented in research designs have no opportunity to demonstrate their interactive effect (Whiteley and Allen, 1969). One long term goal of research is to obtain answers to the question, "What treatment by whom is most effective for this individual with that specific problem under which set of circumstances?" (Thoresen, 1966). This paper deals with a study designed to pursue this basic question.

The study, implemented at Stanford University, explored the differential effects of two group counseling treatments on career exploratory behaviors of adolescents. One treatment employed video-taped social models while the second treatment was based on structured group interaction using written stimulus materials. In an attempt to relate S characteristics to treatment effects two predictor variables, personality type (extraversion-introversion) and perceptual orientation (field independence-field dependence), were included in the study.

The choice of the personality variable of extraversion-introversion was based largely on the work of Eysenck (1960; 1967). He argues that for maximum effectiveness different counseling procedures should be used with introverts and extraverts. According to Eysenck the introvert is responsive to procedures involving considerable reflective and imagery related behaviors while the extravert should be involved in group interaction and other procedures based on movement and action.

The perceptual orientation variable was also chosen because of its possible relationship to the treatment effects. Research of Witkin and his associates (1962; 1964; 1965; 1967) suggests that perceptual field independence-dependence may be important in observational learning. According to Witkin Ss who are high in the "ability to perceive objects apart from . . . context" (Witkin, 1964, p.176) are classified as "field-independent" while those low in this ability are termed "field dependent." In the present study it was hypothesized that perceptually independent Ss would be more influenced by the video-taped models while the perceptually dependent Ss would be more influenced by the structured stimulus materials treatment.

Method

Subjects

The present study was replicated in three suburban high schools located in the vicinity of Stanford University. In each school a standardized announcement form regarding an opportunity to take part in a special four week career planning program was distributed to all eleventh grade male students. Students in each school who indicated an interest were initially contacted and assessed as to their personality type and perceptual orientation. Ss were stratified by their scores on these two individual difference variables and then randomly assigned to treatment, control and reserve groups. Thirty-two Ss were assigned within each school; total N = 96.

Experimental Treatments

A detailed description of the experimental treatments has been reported elsewhere (Thoresen and Hamilton, 1969). Only a brief review will be presented here.

Structured stimulus materials. Planned stimulus materials were used in small group counseling sessions consisting of 8 Ss per group, led by one counselor. The groups met once a week for four weeks. The written stimulus materials were designed to assist adolescents in identifying career goals, gathering relevant and reliable information, processing information and considering alternatives. During each small group session the counselor verbally and nonverbally reinforced S responses, such as asking effectively phrased questions relevant to a particular occupational characteristic.

Peer social modeling. Four video-presented peer social modeling sessions were used in four meetings paralleling the content of the structured stimulus materials. In each meeting, Ss observed a video tape in which four peer social models and a model counselor discussed specific ways of gathering information and processing it according to preferences and alternatives. On each video tape the model counselor verbally and nonverbally reinforced career relevant responses on the part of the model students. No group discussion occurred after Ss viewed the video tape.

Criteria

The effects of treatment procedures were evaluated by: (1) knowledge test of how to obtain and to use relevant and reliable career information, (2) simulated career decision situation test where the S was asked to imagine himself in a hypothetical setting and to list appropriate career exploratory behaviors, and (3) frequency and (4) variety of career exploratory behaviors of Ss outside the treatment setting.

The first administration of all criterion instruments took place one week before treatment sessions began. The second administration of the knowledge and the simulation tests occurred one week following the final (fourth) treatment sessions. The frequency and variety of career exploratory behaviors were assessed for the second time four weeks following the final treatment sessions.

Analyses

The first criterion variable selected for analysis was the simulation test. A two phase regression analysis was performed (Darlington, 1968). First, the post-test simulation scores were regressed on the pre-test simulation scores. That portion of a S's post-test score which deviated from what would have been predicted from the pre-test score by linear regression was called his residual score. This residual score was considered to contain the effects due to treatment. The larger the residual, or deviation from predicted score, the larger the treatment effect for that individual. The second phase was to regress a S's residual score separately on each of his predictor variable scores.

Findings from these regression analyses computed in all three schools showed that most of the post-test variance was predicted from the pre-test scores, leaving little variance to be accounted for by the predictor variable scores. The greatest proportion of the residual variance that any one predictor variable accounted for was .04. Thus neither personality nor perceptual scores of Ss predicted their residual simulation test scores in any of the three schools.

Since no predictive relationship was found between either of the individual difference variables and the simulation criterion, it was decided, before going further with regression analysis, to compute six two-way analyses of

variance (two treatment levels by four levels of Ss: field independent-introverted; field independent-extraverted; field dependent-introverted; field dependent-extraverted). These tests determined whether there were significant interactions between any of the predictor variables and the experimental treatments on the remaining criterion variables: knowledge test, frequency and variety of career exploratory behaviors. In these analyses, significant interactions served as indicators that regression analysis should be performed to determine whether S differences in perceptual performance or personality type would correspond to differences in treatment effects.

Significant interactions ($p < .05$) between the two predictor variables and the criterion variables of frequency and variety of career exploratory behaviors were found at one school (Mills). Regression analysis was then performed on the peer social modeling and structured stimulus materials treatments at Mills. Each predictor variable was tested separately in relation to frequency and variety of career exploratory behaviors.

The purpose of the regression analysis was to investigate the relationship between each of the predictor variables and the treatment effects. To carry out this investigation the analyses were performed in such a way that both the pre-test and perdictor variables were placed in regression equations designed to predict post-test scores. The equations have the general form $\hat{Y}=a+b_1x1+b_2x2$ where "$\hat{Y}$" is the predicted post-test scores; "a" is a constant; b_1 is the regression weight for the pre-test; x_1 is the pre-test score; b_2 is the regression weight for the predictor variable and x_2 is the predictor variable score.

Results

The results of the analyses are presented in Table I in terms of the three important parameters of the regression equations, "a", "b_1" and "B_2". For each regression equation "R_1^2" or the amount of variance in the post-test which is accounted for by the pre-test is presented. Finally the increase in "R^2" resulting from the addition of the predictor variable to the equation is also reported for each equation. The size of "R_1^2" is an indicator of the degree of relationship between pre- and post-test. The increase of "R^2" is important because it reflects the amount of criterion variance (treatment effect) accounted for by a particular predictor variable.

Findings showed that the greatest proportion of the residual variance that any one predictor variable accounted for was .09. In general, little association was found between either of the predictor variables and residual scores obtained from regressing post-test on pre-test scores.

Discussion and Implications

Taken at face value the results indicate little relationship between predictor variables and treatment effects. However because of various difficulties with some of the procedures used in the study a conclusion of no relationship is not warranted at this point. In this section these difficulties will be identified and discussed for the purpose of developing suggestions for future research.

Sample size. The first difficulty to be discussed concerns sample size. A minimum sample size for regression analysis is N=30. As shown in Table I the largest sample size for any single regression analysis in this study was N=16. A sample size of sixteen is not large enough to permit the drawing of reliable inferences concerning the relationships between variables. The small "N", therefore,

may have contributed significantly to the apparent lack of relationship between treatment effects and predictor variables. Subsequent studies should select a sample size of at least N=30 if regression analyses are to be performed.

Nonlinear relationship. A second problem involved the choice of data to be used in the regression analysis. In the present study the data for all Ss in a treatment were used in the analyses for that treatment. The difficulty is that the interaction between treatment effects and predictor variables may have existed only for Ss who scored at the extremes on the predictor variables. For example, an extreme introvert may have been much more responsive to the modeling treatment than an extreme extravert while a less extreme introvert and a less extreme extravert may have shown no difference in responsiveness. Since scores of all Ss were used in the analyses, the data for the less extreme Ss may have confounded relationships present only for extreme Ss. In future studies this situation could be dealt with in either of two ways: 1.) In each analysis use only data from Ss scoring at the extremes on the predictor variables, 2.) use the data from all Ss but include an X-squared term in the regression equation. The use of the X-squared term would enable one to assess the strength of this curvilinear relationship between predictor variable and treatment effects.

Pre-treatment variability among Ss. A third difficulty is related to the manner in which Ss were selected. As explained above volunteers were solicited from among eleventh grade male students. Students who volunteered were randomly assigned to treatments without attention to initial levels of skills in gathering and processing career-relevant information. Consequently each treatment group contained some Ss who from the outset were more skilled in information gathering and processing than other Ss in the same treatment. It is quite possible that these "advanced" Ss showed less change as a result of treatment than Ss with lower levels of skills. This is possible because the "advanced" Ss had less

room for improvement than the other Ss. The net result of a lack of change for"advanced" Ss would be a tendency to mask any relationship between predictor variables and treatment effects particularly if the "advanced" Ss had been assessed as extreme on either of the predictor variables. In future research a more productive strategy would be to select as Ss only individuals who do not show well developed skills on the criterion variables prior to treatment.

"Ceiling effect" of criterion measures. The apparent lack of relationship between predictor variables and treatment effects may have been partially due to difficulties with criterion variables. There were indications that for two variables, the knowledge test and the simulation test, there was a "ceiling effect" which may have masked treatment effects. It was not unusual for treatment groups to have an average score of twelve or thirteen on the twenty-item knowledge test. For those individuals scoring high on the pretest there was little room for improvement in their score. The simulation test may have contained a different kind of ceiling. This test contained a description of a simulated decision situation. The S was asked to list such things as questions to which he would like to obtain answers, and sources to which he would probably go for information. Due to constraints within the school setting there was a limit on the time a S could spend on the simulation test. Consequently if a S had worked diligently on the pre-test, it would have been difficult for him to show marked gains due to treatment on the posttest largely because of the time limit. To correct these problems in future studies it would be necessary to construct a knowledge test with many more items of varying difficulty and to provide Ss with unlimited time to complete the simulation test. Having Ss record their answers on audio tape instead of writing them, for example, might speed up the administration of the test.

Hidden figures test. Questions can also be raised concerning the appropriateness of the instrument used to measure perceptual orientation. The Hidden Figures Test (French, Ekstrom and Price, 1963) used to assess perceptual field independence-dependence consisted of two sections of 16 questions. Ss were given 10 minutes on each section and were required to find a geometric figure, embedded in one of five complex "fields," that corresponded to a given design. In retrospect many Ss seemed to have required a "warm-up" period. For them scores on the second section were much higher than on the first. Other Ss failed to complete the test after finding it very difficult to detect several of the figures. They invariably received scores of "0" on the second part. In both situations Ss' scores reflected the effects of learning and motivational variables in addition to their actual performance. Future investigations should explore the use of alternative instruments to assess perceptual field independence-dependence coupled with improved ways of administering instruments to Ss.

Scope of criterion assessment. A sixth difficulty in the present study concerns the variety of criterion variables. Two criterion variables measured Ss' knowledge of and ability to use steps in a decision making process. The other two criterion variables measured Ss' information seeking behaviors. Did these measures cover all of the relevant variables? In other words was there an unmeasured variable which was more responsive to the treatments than those variables the study measured? For example, although few treatment effects were exhibited by the present criterion variables (Thoresen and Hamilton, 1969), it is possible that there were important changes in the attitudes which the Ss held toward career information gathering and processing. However since these attitudes were not measured, it was impossible to relate changes in attitude to predictor

variables. The implications for future studies are clear: Attention must be given to assessing Ss on all variables which may reflect treatment effects and which are of interest to the experimenter.

Treatment objectives. A related problem pertains to the purposes for which the experimental treatments were designed. The objectives were to teach Ss how to use the steps in a decision making paradigm and to stimulate them to seek information relevant to career choice. These objectives were to be achieved in four, fifty-minute treatment sessions. It is quite possible that the objectives were too broad and the sessions too few. In other words by attempting to accomplish so much in only four treatment sessions, too little treatment time and emphasis were devoted to the accomplishment of any one objective. The net result may have been that none of the objectives were achieved. In order to remedy this situation it would be necessary either to narrow the focus of the treatments or to provide for many more treatment sessions. In this way the probability of important treatment effects would be increased. Correspondingly there would be a greater likelihood of finding an important relationship between the predictor variables and treatment effects.

Data analysis procedures. A seventh factor which may have contributed to the present lack of results is the type of analysis which was performed. The regression analyses in this study dealt separately with each predictor variable and each criterion variable. Thus in any one analysis only one criterion variable (e.g. frequency of career exploratory behaviors) was regressed on only one predictor variable (e.g. extraversion-introversion). Dealing with the variables separately assumes that they are in general independent of each other. The problem is that although the predictor variables were independent of each

other, the criterion variables did exhibit important inter correlations. The predictor variables correlated r = 0.06. The correlations between criterion variables ranged from r = 0.08 to r = 0.96. The knowledge and simulation tests tended to correlate r = 0.40. These two tests, however, did not correlate with frequency and variety (e.g. r = 0.08). Frequency and variety correlated r = 0.96. When criterion variables overlap, an analysis which deals with the variables separately tends to waste information. A more useful procedure would be one which analyzes the data in terms of sets of variables.

Canonical correlations may have been more appropriate for this study than regression analysis because it does deal with data in terms of sets of variables. This procedure differentially weights individual variables so as to produce a maximum correlation between linear functions of two sets of variables (Cooley and Lohnes, 1962). If used in the present study, the procedure would have developed different weights for each predictor variable and the treatment effects exhibited by each criterion variable so as to produce a maximum correlation between a linear combination of predictor variables and a linear combination of criterion variables. Canonical correlation would thereby make use of the overlap among variables to provide a more complete description of the relationship between predictor variables and treatment effects.

Future designs. To this point the suggestions for future research have dealt with ways in which the present study could be altered so as to increase the probability of finding important relationships between predictor variables and treatment effects. The final suggestion focuses on a completely different design. In the present study single pre- and posttreatment measurements were taken on the dependent variables. This procedure may have resulted in much important data being missed. For example, what happened during treatment?

It is possible that important changes took place at different points while the treatments were in progress. The present design provides no information relevant to these changes. Future inquiries, examining interactive effects of such variables as subject characteristics, specific treatments, counselor characteristics and multiple outcome measures, should use baseline and "during treatment" continuous assessment techniques to gather data on how Ss are responding through all phases of the study (Thoresen, 1969). This type of measurement procedure may require the use of fewer Ss and/or fewer treatment groups. However, it will yield more complete information on each S and therefore increase the probability of identifying important relationships.

Summary

This paper dealt with a study designed to pursue the question, "What treatment by whom is most effective for this individual with that specific problem under which set of circumstances?" (Thoresen, 1966). One of the objectives of the study was to determine if there was any relationship between two predictor variables (personality type: extraversion-introversion and perceptual orientation: field independence-field dependence) and treatment effects as shown by four criterion variables: 1.) a Knowledge test, 2.) a simulation test, 3.) frequency and 4.) variety of career exploratory behaviors. A stepwise regression procedure was used to analyze the data. No significant relationships were found between treatment effects and predictor variables. A variety of difficulties which may have contributed to these results were identified and implications for future research were presented.

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TABLE I

REGRESSION ANALYSES USING INTROVERSION-EXTRAVERSION AND FIELD INDEPENDENCE-DEPENDENCE AS PREDICTORS, AND FREQUENCY AND VARIETY OF CAREER EXPLORATORY BEHAVIORS AS CRITERIA: MILLS HIGH SCHOOL

Treatment[1]	N	Criterion Variable ($\hat{Y}$)	Constant (a)	Pre-test Regression Coefficient (b_1)	Predictor Regression Coefficient (b_2)	Correlation Coefficient Between Pre- and Post-Test (R_1)	Multiple Correlation Coefficient (R_1^2)	Increase in R^2
PSM	16	Frequency	3.58	.17	-.02 (Personality)	.29*	.08	.00
SSM	15	Frequency	.68	.41	.09 (Personality)	.37*	.14	.07
PSM	16	Frequency	3.76	.21	-.06 (Perceptual)	.29*	.08	.06
SSM	15	Frequency	2.52	.37	.07 (Perceptual)	.37*	.14	.05
PSM	16	Variety	1.92	.37	-.01 (Personality)	.52*	.27	.00
SSM	15	Variety	-.03	.42	.09 (Personality)	.36*	.13	.09
PSM	16	Variety	1.81	.38	-.01 (Perceptual)	.52*	.27	.00
SSM	15	Variety	3.54	.44	-.05 (Perceptual)	.36*	.13	.03

[1]PSM--Peer Social Modeling; SSM--Structured Stimulus Materials.

*p <.05